



This document includes the Summary of Impacts – Aluminum Hulls Vessel Group for the Draft Hull Coating Leachate” Discharge Assessment Report published in August 2003. The reference number is: EPA-842-D-06-002

DRAFT

Discharge Assessment Report

Hull Coating Leachate

Summary of Impacts and Characterization for Aluminum
Hulls Vessel Group

August 2003

6 Summary of Impact – Aluminum Hulls Vessel Group

The Aluminum Hulls vessel group includes 403 vessels and accounts for 13% of vessels of the Hull Coating Leachate discharge; but only 0.46% of the wetted surface area because they have much smaller hull area, on average, than vessels in the other vessel groups. The USCG 47-foot Motor Lifeboat (MLB 47) is the representative vessel for this vessel group.

6.1 Characterization of Aluminum Hulls Vessel Group

For the Aluminum Hulls vessel group, foul-release or advanced antifouling coatings are currently used. The decision regarding which coating type to use is made by local maintenance staff based on issues such as the local rate of fouling growth, the prevalence of ice in a region, and the availability of contractors who are qualified to apply the foul-release coatings. Approximately 90% of these vessels are coated with advanced antifouling coatings and 10% are coated with foul-release coatings (Dust, 2003a). Thus, the baseline discharge from the Aluminum Hulls vessel group results from the use of advanced antifouling and foul-release coatings. *E Paint SN-1* is the advanced antifouling coating used as the basis for these analyses and has a maximum two-year service life. Intersleek 425 is the foul-release coating used as the basis for these analyses with a three-year service life.

As described in Section 3.2.2, foul-release coatings do not release biocides to control biofouling. The release of any other constituents that may be present in Intersleek 425 is expected to be negligible. Toxic or hazardous constituents were assumed not to be released to the environment. Therefore, discharge characterization data is not presented. Information on the constituents released from advanced antifouling coatings are presented in Table 6-1. As presented in the *Hull Coating Leachate ChAR*, any VOCs present in coatings were assumed to dissipate during the drying/coating curing process and are not included in the list of constituents discharged from the coatings characterized.

Table 6-1. Constituent Information for the Baseline Discharge for the Aluminum Hulls Vessel Group

Constituent	Concentration at 1 cm from the Hull (µg/l)	Release Rate (µg/cm ² /day)	Constituent Mass Loading (lb/vessel group-year)	TPE (lb-equiv/yr)	BCC Identified
Sea-Nine211 [®] (4,5-dichloro-2-n-octyl-4-isothiazolin-3-one)	1.0 ^c	1.8 ^a	140	2,900	No
Total Zinc	10 ^c	17 ^c	1,300	84	Reduction

^aManufacturer information; ^bPrevious Navy Studies; ^cScaled from weight percentage or known release rate.

A complete description of the information collected, assumptions made, and calculations performed, to estimate the concentrations and release rates is contained in the *Hull Coating Leachate ChAR*.

6.1.1 Establish a Maximum Allowable Copper Release Rate for Antifouling Coatings

The use of copper-containing coatings on aluminum hulls is not approved by the current specifications for underwater hull antifouling coatings due to the possibility of deposition corrosion (Navy, 2001a; USCG, 2001). Deposition corrosion occurs when copper from the antifouling coating plates out onto an area of bare aluminum substrate, leading to galvanic corrosion of the hull as depicted in Figure 6-1 (Jones, 1992; Lamtec, 2001). Therefore, this MPCD option is not feasible for the aluminum hulls vessel group and no further analysis was conducted.

Figure 6-1. Steps Involved in Deposition Corrosion

Step	Description	Schematic
1	Application of typical copper-containing antifouling coating to an aluminum hull; copper leaches into the surrounding seawater	
2	Mechanical damage occurs to the coating system, exposing bare aluminum	
3	Copper is deposited (plated) as metallic copper on the bare aluminum	
4	Metallic copper causes galvanic corrosion of adjacent areas of bare aluminum	

6.1.2 Foul-Release Coatings

As previously stated, the unique surface chemistry of foul-release coatings creates a surface to which fouling cannot easily adhere (NRL, 1997). The U.S. Environmental Protection Agency (EPA) has determined that foul-release coatings are exempt from reporting under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (Public Law 95-396), because biocides are

not released to control biofouling. The release of any other constituents that may be present in Intersleek 425 is expected to be negligible. Therefore, toxic or hazardous constituents were assumed not to be released to the environment. Discharge characterization data is not presented.

International Intersleek 425 is the only foul-release coating approved for use on Armed Forces vessels and is used as the basis for all analyses. International Intersleek has a service life of three years on vessels in the Aluminum Hulls vessel group.

6.1.3 Advanced Antifouling Coatings

As described in Section 4.1.3, advanced antifouling coatings have many environmental advantages, because the coating formulations do not contain tributyltin (TBT), the quantity of copper can be reduced or eliminated, and new non-persistent biocides can be incorporated. Some advanced antifouling coatings contain copper and a non-metallic co-biocide while others are based on non-metallic biocides.

The USCG has approved one copper-free advanced antifouling coating for use on smaller, aluminum-hulled USCG vessels – *E Paint SN-1* (USCG, 2000). This coating contains the patented biocide Sea-Nine211[®]. *E Paint SN-1* has a maximum service life of two years and is more durable and easier to maintain than foul-release coatings (USCG, 2000). Advanced antifouling coatings have failed to meet the minimum performance requirements in MIL-PRF-24647 and are not qualified for use on Navy vessels (Lawrence, 2003). Table 6-2 presents the constituent information from the discharge of advanced antifouling coatings to all vessels in the Aluminum Hulls vessel group. Information supplied from the E Paint Company is the major source of information for the discharge.

Table 6-2. Estimated Constituent Information for the Discharge from the Use of Advanced Antifouling Coatings on All Vessels of the Aluminum Hulls Vessel Group

Constituent	Concentration at 1 cm from the Hull (µg/l)	Release Rate (µg/cm ² /day)	Constituent Mass Loading (lb/vessel group-year)	TPE (lb-equiv/yr)	BCC Identified
Sea-Nine211 [®] (4,5-dichloro-2-n-octyl-4-isothiazolin-3-one)	1.0 ^c	1.8 ^a	150	3,200	No
Total Zinc	10 ^c	17 ^c	1,400	93	Reduction

^aManufacturer information.

^bPrevious Navy Studies.

^cScaled from weight percentage or known release rate.

A complete description of the information collected, assumptions made, and calculations performed to estimate the concentrations and release rates is contained in the *Hull Coating Leachate ChAR*.

6.2 Feasibility Impact Analysis of Aluminum Hulls Vessel Group

The feasibility analysis assessed the practicability and operational impact of the three MPCD options groups as well as the possible cost to implement each MPCD option. The choice of hull coating directly affects a vessel's ability to satisfy mission requirements as well as the normal drydocking and maintenance schedules for vessels. Costs were estimated to implement each MPCD option. MPCD options are estimated to incur costs to modify the existing military specification, manuals, and contracts that determine which coating may be used on vessels. Additional costs were estimated for the increased maintenance and application of coatings resulting from the use of the MPCD options.

The MPCD option to Establish a Maximum Allowable Copper Release Rate for Antifouling Coatings is not feasible for the Aluminum Hulls vessel group due to the possibility of deposition corrosion.

Foul-release coatings are currently used on 10% of vessels in the Aluminum Hulls vessel group. Foul-release coatings allow marine organisms to grow on the hull and rely on the flow of water across the hull or hull cleaning to remove any fouling that does not grow on the hull during periods of inactivity.

Advanced antifouling coatings are used on 90% of the vessels in the Aluminum Hulls vessel group. The use of advanced antifouling coatings would not have significant impacts on mission capabilities or costs, but the decision to use alternate coatings is important in the ability of maintenance staff to properly deal with local issues (e.g., applicator qualifications, hull fouling rate).

A summary of the feasibility impacts of using each MPCD option on all vessels in the Aluminum Hulls vessel group is presented in Table 6-3.

Table 6-3. Feasibility Impact Summary for the Aluminum Hulls Vessel Group

MPCD Option	Analysis Factors				
	Mission Capabilities	Drydock and Pierside Maintenance	Initial Costs (\$K, in 1999 dollars)	12-year Recurring Costs (\$K, in 1999 dollars)	Annualized Total Ownership Costs (\$K, in 1999 dollars)
Baseline Discharge (Foul-Release and Advanced Antifouling Coatings)	None	None	0	21,000	1,800
Establish Maximum Copper Standard	MPCD option is not feasible				
Foul-Release Coatings	Reduces speed, range, and mission availability	Increased pierside maintenance	12	25,000	2,100
Advanced Antifouling Coatings	None	None	55	21,000	1,800

A complete description of the impacts identified, costs, and assumptions is contained in the *Hull Coating Leachate FIAR*.

6.3 Environmental Effects Analysis of Aluminum Hulls Vessel Group

The environmental effects were analyzed for the baseline discharge and discharges resulting from each MPCD option. The baseline discharge results from the use of advanced antifouling and foul-release coatings. Approximately 90% of the aluminum vessels are coated with advanced antifouling coatings and 10% are coated with foul-release coatings (Dust, 2003a). The environmental effects of the Hull Coating Leachate discharge for the various MPCD options and baseline discharge for Aluminum Hulls vessel group were evaluated and are summarized in Table 6-4.

Table 6-4. Summary of EEA for the Aluminum Hulls Vessel Group

	Baseline Discharge	Establish Maximum Copper Standard	Foul-Release Coatings	Advanced Antifouling Coatings
Number of Constituents Exceeding Strictest WQC	0	NF	0	0
Total Number of Exceeded WQC	0		0	0
Number of Exceeded Narrative Categories	0		0	0
Discharge Hazard Index at 35 m Edge of Mixing Zone	5.7×10^{-3}		0	5.7×10^{-3}
Potential Nonindigenous Species Release	Baseline		Increased from Baseline	Decreased from baseline
Number of BCCs Identified	1		0	1
Discharge Mass Loading of All Constituents (lb/yr)	1,400		0	1,500
Discharge TPE (lb-equiv/yr)	3,000		0	3,300
Other Environmental Impacts – VOC emissions, solid waste generated	Baseline		- Reduced VOC emissions from baseline. - Increased solid waste generated from baseline.	- Increased VOC emissions from baseline. - Reduced solid waste generated from baseline.

NF = MPCD Option was determined to not be feasible.

For the Aluminum Hulls vessel group, the following is the MPCD ranking by overall environmental effect (e.g., “1. Foul-release Coatings” has the least environmental effect):

1. Foul-release Coatings
2. Baseline Discharge
3. Advanced Antifouling Coatings

In summary, foul-release coatings have a discharge TPE of zero, are unlikely to result in any WQC exceedences, and contain no identified BCCs. Therefore, the use of foul-release coatings would result in the least environmental impact. Advanced antifouling coatings have a discharge TPE of 3,300 lb-equiv/yr, and the primary biocide is non-persistent. Additionally, advanced antifouling coatings are unlikely to result in any WQC exceedences and contain one identified BCC. The baseline discharge is a combined use of the foul-release and advance antifouling coatings MPCD options, and therefore, is ranked between the two. None of the MPCD options is expected to result in acute toxicity 35 m from the hull.

6.4 Cost-Effectiveness Analysis of Aluminum Hulls Vessel Group

As a means of comparing the various MPCD options, the incremental pounds removed for each MPCD option is compared to the baseline discharge. These pounds removed are then compared with the incremental cost of each MPCD option. Finally, a cost-per-pound removed is calculated

and used to compare the MPCD option cost-effectiveness. The comparison results are presented in Table 6-5. As shown below, the use of foul-release coatings would remove 3,000 lb-equiv/yr from baseline at an incremental cost of \$300,000 per year resulting in an incremental cost of \$100 per pound removed. The use of advanced antifouling coatings would increase the total quantity discharged by 300 lb-equiv/yr, as noted by the “-300,” and is estimated to decrease the cost of coating from the baseline by \$29,000 on an annual basis, as noted by the “-29.” For the use of advanced antifouling coatings, the incremental cost per pound removed is not an applicable calculation when the incremental pounds removed increases and the incremental annualized cost decreases, as noted by the “N/A.”

Table 6-5. Cost-Effectiveness Analysis of MPCD Options for the Aluminum Hulls Vessel Group

	Establish Maximum Copper Standard	Foul-Release Coatings	Advanced Antifouling Coatings
Incremental TPE Removed from Baseline (lb-equiv removed/yr)	NF	3,000	-300
Incremental Annualized Cost from Baseline (\$K, in 1999 dollars)	NF	300	-29
Incremental Cost per TPE Removed (\$/lb-equiv removed)	NF	0.10	N/A

N/A = The incremental cost per pound removed is not applicable when the incremental pounds removed increases and the incremental annualized cost decreases.

NF = The MPCD Option is not feasible for this vessel group.